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SOURCE Elektroiskrovaya obrabotka metallov (Electric-Spark Machining of Metals).

SOVIET UNIVERSAL ELECTRIC-SPARK MACHINE TOOL

V. M. Baranov  
 G. L. Perfil'yev

A universal electric-spark machine tool with automatic electrode feed is suitable for performing various metal-cutting operations and for experimenting with various methods of electric machining.

The work piece is secured to the bed plate by a clamp. The electrode is secured to the tool head by another clamp. The carriage which carries the tool head with the electrode can travel vertically on its guide screw; a fly wheel is mounted on this screw. The carriage feed can be either manual or mechanical. When mechanical feed is used, a motor activates a shaft through a reduction gear. A dog attached to the shaft strikes a pin which protrudes from the side of the flywheel. This sets the flywheel and attached guide screw into motion. As a result, the tool-carriage feed moves downward. Two bus bars conduct the current from the capacitor to the work piece and electrode by means of wires.

The oil tank is lifted with a hand crank through a system of levers so that the bed plate with the work piece and electrode are submerged in the liquid dielectric.

The clamp which secures the tool head on the carriage adjusts the vertical sliding of the electrode-tool in keeping with its length and wear. The clamp permits quick tool-head change depending on the type of head required, such as a head for the contactless method, a head with vibration feed of the electrode, or a head with electromagnetic feed of the electrode, i.e., with a so-called floating spindle. In the latter cases the carriage serves only for the initial setting of the tool. When the operation is a long one and there is a great deal of tool wear, periodic manual adjustment is accomplished through the carriage.

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The large-diameter bus bars permit easy feeding of current to various-sized tools and work pieces. A cross-connection socket permits change of polarity and quick disconnection of leads so that if the tank should burst into flame, an iron cover could be put over the entire apparatus. The tank may catch fire during experimentation with easily inflammable media if a spark jumps over the surface of the tank.

The unit which feeds the current to the apparatus consists of a direct-current motor-generator of 250 volts, 15 amperes, and a condenser bank (C = 300 microfarads), which are connected in an ordinary circuit with appropriate resistors and measuring instruments.

In making a milling cutter for high-speed milling, hard-alloy blades had to be cut according to a drawing. The width of the blade was 7 millimeters and the length of cut was 25 millimeters; therefore, the cross section of the cutting surface was 175 square millimeters. The cutting was done with a 1.5-millimeter-thick cuprite bar, the width of which was greater than that of the blade at the point of cutting. The blade being cut was clamped in a special jig and mounted on the table in the apparatus. The jig had a slit 1.5 millimeters wide for guiding the electrode bar along the line of cut. The other end of the bar was secured by a jig on the tool head. The use of the jig considerably simplifies the construction of machine tools for electric-spark machining, making it possible to manufacture them without complex or expensive precision guides which are usually found on metal-cutting machine tools. The feeding was done automatically by the motor through a reduction gear since the cutting was carried out by the contactless method.

Electrical conditions for the cutting were as follows: capacitance, 200 microfarads; potential, 150 volts direct current; charging current, 6 amperes. Time required to cut one blade was 15-18 minutes. The wear of the cuprite bar when cutting the hard-alloy blade was equal to twice the thickness of the blade being cut.

The cutting of 12x12-millimeter bars of tempered carbon steel was accomplished in 2 to 3 minutes with a 1.5-millimeter-thick copper bar on this same machine tool with 200 microfarad capacitance, 175-volt potential, and an 8-ampere charging current.

Piercing a hole in 21-millimeter-thick red-hot sheet steel for manufacturing a matrix for a die was done on this machine tool with a hollow profile punch made from copper tubing which was compressed on a mandrel to the required shape. Various operating conditions were used in piercing the hole to determine which would be most effective when machining with manual feed and by the contactless method. Results of the experiment are given in the following table:

| Depth of<br>Pass for<br>Given<br>Setting<br>(mm) | Total<br>Depth of<br>Pass<br>(mm) | Time per<br>Pass<br>(min) | Capaci-<br>tance<br>(mfd) | Voltage<br>(volts) | Charging<br>Current<br>(amp) | Time per<br>Mm of Cut<br>(min) |
|--|-----------------------------------|---------------------------|---------------------------|--------------------|------------------------------|--------------------------------|
| 8  | 1-8                               | 80                        | 200                       | 120                | 5-6                          | 10                             |
| 10   | 8-18                              | 25                        | 200                       | 150                | 8                            | 2.5                            |
| 3  | 18-21                             | 4                         | 200                       | 170-200            | 10-12                        | 1.33                           |

From the table it is clear that when the voltage and current are increased, the productivity of the process increases considerably. Under the last setting the entire operation took only 35 minutes, whereas for the first setting, 220 minutes were consumed.

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The industrial use of electric-spark machining is expedient in the following operations: cutting hard-alloy blades of any profile for soldering on edges of complex and irregularly shaped tools; drilling hard-alloy drawing dies of any profile with diameters as small as 0.2 millimeter without the use of expensive tools and abrasives; granulating various metals; engraving; making profile recesses; extracting, quickly and cheaply, broken tools from parts such as internal combustion engines, pneumatic machines, etc., without damage to them; manufacture of small blanking dies and swaging (ob'yemnyy) dies; and grinding cutting tools with hard-alloy tips. This machine tool can also be used for further research work on the process.

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